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[Multi-epoch Doppler tomography and polarimetry of QQ Vul] Multi-epoch Doppler tomography and polarimetry of QQ Vul Based in part on observations at the European Southern Observatory La Silla (Chile) with the 2.2m telescope of the Max-Planck-Society

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abstract We present multi-epoch high-resolution spectroscopy and photoelectric polarimetry of the long-period polar (AM Herculis star) QQ Vul. The blue emission lines show several distinct components, the sharpest of which can unequivocally be assigned to the illuminated hemisphere of the secondary star and used to trace its orbital motion. This narrow emission line can be used in combination with Na $i - absorptionlinesfromthephotosphereofthecompaniontobuildastablelong-termephemerisforthestar : inferiorconjunct$ $244\,8446.4710(5) + E \times 015452011(11)$. The polarization curves are dissimilar at different epochs, thus supporting the idea of fundamental changes of the accretion geometry, e.g. between one- and two-pole accretion modes. The linear polarization pulses display a random scatter by 0.2 phase units and are not suitable for the determination of the binary period. The polarization data suggest that the magnetic (dipolar) axis has a co-latitude of 23, an azimuth of -50, and an orbital inclination between 50 and 70.

Doppler images of blue emission and red absorption lines show a clear separation between the illuminated and the non-illuminated hemisphere of the secondary star. The absorption lines on their own can be used to determine the mass ratio of the binary by Doppler tomography with an accuracy of $15\% - 20\%$. The narrow emission lines of different atomic species show remarkably different radial velocity amplitudes: $K = 85 - 130\,km\,s^{-1}$. Emission lines from the most highly ionized species, He $ii, originateclosesttotheinnerLagrangianpoint$ L_1. We can discern two kinematic components within the accretion stream; one is associated with the ballistic part, the second with the magnetically threaded part of the stream. The location of the emission component associated with the ballistic accretion stream appears displaced between different epochs. Whether this displacement indicates a dislocation of the ballistic stream, e.g. by a magnetic drag, or emission from the magnetically threaded part of the stream with near-ballistic velocities remains unsolved.